(12) UK Patent Application (19) GB (11) 2 225 934 (13) A

(43) Date of A publication 20.06.1990

(21) Application No 8927234.8

(22) Date of filing 01.12.1989

(30) Priority data
(31) 3841372 (32) 08.12.1988 (33) DE

(51) INT CL[5]
A47L 15/42, D06F 39/08

(52) UK CL (Edition K)
A4F F29A2A
D1A ADA

(56) Documents cited
None

(58) Field of search
UK CL (Edition J) A4F , D1A ADA ADX
INT CL[4] A47L, D06F

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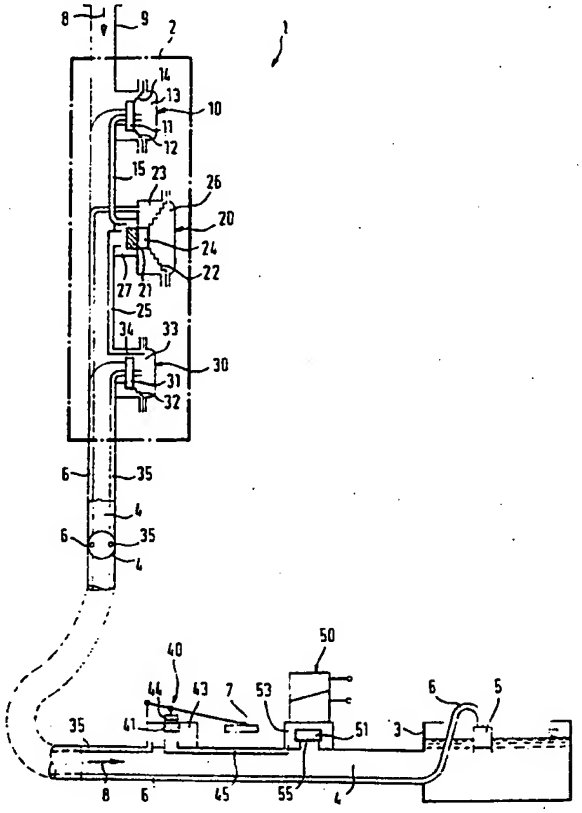
(54) **Regulating water supply to dishwashing and laundry washing machines**

(57) The flow of water from a tap to a water container 3 of a dishwashing or laundry washing machine via inlet hose 4 is regulated by a flow control system comprising valves 10, 20, 30, 40, 50. In use, either one or both of shut-off valves 10, 30 is or are closed in response to closure of any one of valves 20, 40, 50. In the event of electrical current failure, servo-valve 50 closes causing valves 10, 30 to close. In the event of a leak into a leakage water-collecting trough, float valve 40 closes causing valves 10, 30 to close. In the event of water rising to a predetermined level in container 3, air pressure within chamber 5 actuates valve 20 to cause valve 10 to close. The inlet hose may comprise pneumatic duct 6 and hydraulic duct 35. Operation of servo-valve 50 may be controlled by a programming control device.



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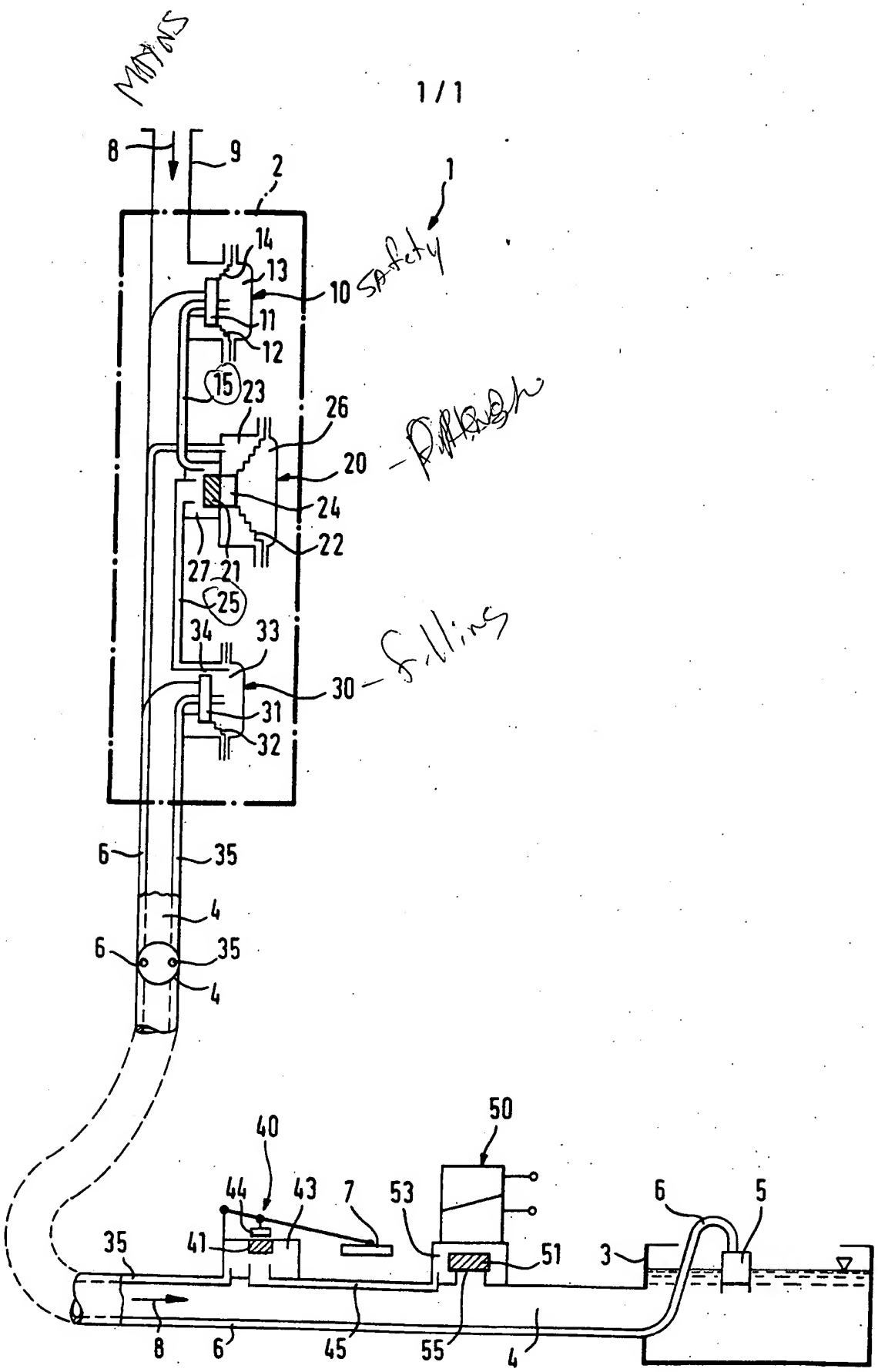
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WATER-FILLING AND SAFETY MEANS IN A LIQUID-CONDUCTING APPLIANCE

The present invention relates to a liquid-conducting appliance, especially a household appliance, and has particular reference to water-filling and safety means in such an appliance.

A water-filling and safety device for a liquid-conducting household appliance is disclosed in DE-PS 34 40 695, wherein an inlet hose, which opens free of valve into the inlet of the machine container, is connected by way of a valve arrangement with two valves connected in series to a shut-off cock of a water mains. An electromechanical valve, controlled by a program control device, in the valve arrangement is arranged in series with a mechanically actuable valve connected by way of a pneumatic duct with the pressure chamber of a level-regulating vessel. A switching device, which is disposed in a leakage water collecting trough arranged at the base in the appliance and is actuated by a float, is installed in a control line from the program control device to the electromagnetic valve. On actuation of the switching device by the float, the current circuit to the electromagnetic valve is interrupted so that this closes.

In the known device, a control line at mains voltage is led to the electromagnetic valve. In order to provide protection against touching, the valve arrangement must be surrounded by a housing which must be closed off in watertight manner in order to avoid short-circuits. Moreover, special measures have to be provided at the connection of the terminals with the coil of the electromagnetic valve for protection against corrosion and terminal faults, for example short-circuits. The housing of the known valve arrangement also has relatively large dimensions, since the electromagnetic valve projects some distance out of the valve arrangement. This entails disadvantages for the user

when making the connection to the usual shut-off cock of a water mains disposed at the wall of a building, since the spacing between the connecting thread of the shut-off cock and the wall is relatively small. The pressure-dependent valve, which is connected to the pressure chamber of the level-regulating vessel, of the valve arrangement is actuated only for the switching of the safety level, since the usual filling level control is effected by a float or other measure. This means that this valve switches only in the event of a fault and is thus not actuated for a long time. Consequently, there is a risk that this valve sticks.

A water-filling and safety device for liquid-conducting household appliance is also disclosed in DE-PS 34 25 587, in which device the inlet hose is connected by way of a pressure-dependent valve to the shut-off cock of the water mains. The valve is constructed as a differential diaphragm valve in which one chamber is coupled to a pneumatic pressure pulse transmitter and the other chamber to a pressure chamber of the level-regulating vessel. A pressure-dependent safety valve arranged at the machine can also be provided, this valve being coupled to a second pressure chamber, which is set to a safety level, of a second level-regulating vessel. Moreover, the safety valve at the machine can be equipped with a switching device switched by a float arranged in a leakage water collecting trough. The pneumatic pressure pulse transmitter can be included in the program control device or arranged as a separate device driven by electrical pulses from the program control device.

Driving of a valve in the known device by way of inevitably very long pneumatic control ducts entails a degree of inaccuracy in the

switching of the differential diaphragm valve, due to the compressibility of the air in the ducts. A safety valve arranged at the machine in case of erroneously closed safety valve entails the risk that the inlet hose is disposed under pressure on opening of the valve arranged at the shut-off cock of the water mains. Again, the safety valve in this arrangement is switched on only in the safety case so that, if the safety valve sticks, there is a risk that it does not react in the safety case.

There is therefore a need to increase the reliability of safety measures for water-conducting appliances, with more accurate and simpler control techniques.

According to the present invention there is provided a liquid-conducting appliance provided with water filling and safety means comprising an inlet hose connected to an inlet of a water container of the appliance, a valve unit for connection of the hose to a source of water supply and comprising two shut-off valves which are arranged in series and which each include a pressure chamber, the hose and valve unit defining an inlet duct, and a plurality of control valves each including a switching chamber, the pressure chambers and switching chambers being arranged in series in a hydraulic duct connected at inlet means thereof to the inlet duct upstream of the upstream one of the shut-off valves and at outlet means thereof to the inlet duct downstream of the downstream one of the shut-off valves, and a first one of the control valves being arranged to control communication of the outlet means of the hydraulic duct with the inlet duct.

The water filling and safety means may provide an increase in safety and a simple control technique, since the two shut-off valves,

which are connected in series and may be arranged at the shut-off cock of a water mains, are interconnected and thus influence each other and switch together. In addition, the hydraulic control may ensure exact switching behaviour of the valves. An electrical control line to the shut-off cock is avoided and the valve arrangement can be substantially reduced in its overall size through use of two hydraulically controlled valves.

Preferably, each of the control valves switches independently of the others through closing of the hydraulic duct of at least one of the two hydraulically controllable shut-off valves. This provides a further increase in safety.

In a further preferred feature, one of the control valves is arranged between the shut-off valves arranged in series. Advantageously, this control valve is a pressure element, the pressure chamber of which is connected by way of a pneumatic duct with a pressure chamber of a level-regulating device of the appliance. Safety is thereby enhanced, since the first valve, in flow direction, of the series is driven directly by the translation of the air pressure produced, in a first safety case, in the pressure chamber, which is set to a safety level.

For preference, the control valve at the outlet means of the hydraulic duct is connected with program control means of the appliance. Expediently, this control valve is an electrical servo-valve. A particularly simple control technique is achieved by the control of the output of the hydraulic duct into the inlet hose through the program control means.

Preferably, one of the control valves is a switching device

controlled by level-sensing means, such as a float. A further increase in safety is thus achieved if one of the control valves is switched by the float, which is arranged in a leakage water collecting vessel. A second fault case, namely overflowing into the leakage water collecting vessel, thus acts on the water filling and safety means by a simple measure, namely closing of the hydraulic duct.

Expediently, the hydraulic duct at the entry side is connected with the inlet hose by way of a control pressure opening, constructed as flow throttle, in the hydraulically controllable valves.

For preference, the hydraulic and the pneumatic ducts extend in the inlet hose. Alternatively, the two ducts can be connected with wall means of the inlet hose or formed integrally with the wall means. Thus an external enveloping hose, necessary for protection of a control line, around the inlet hose can be dispensed with.

An embodiment of the present invention will now be more particularly described by way of example with reference to the accompanying drawing, the single figure of which is a schematic representation of water filling and safety means in an appliance embodying the invention.

Referring now to the drawing, there is shown a water-filling and safety device 1 in a liquid-conducting household appliance, in particular a dishwashing or laundry washing machine with a program control device. The filling and safety device comprises an inlet hose 4, which opens, free of valving, into an inlet of a container 3 and is connected by way of a valve arrangement 2 to a shut-off cock of a water mains. A level-regulating vessel with a pressure chamber 5, which is connected by a pneumatic duct 6 with the valve arrangement 2, is arranged in or beside the container 3 in liquid communication

therewith. A float 7 is arranged in a leakage water collecting trough (not shown) at the base of the appliance.

A safety valve 10, a pressure element 20 and a filling valve 30 are arranged in series in the valve arrangement 2, which can be enclosed by a housing, in the sequence illustrated by the arrows 8. The valve arrangement 2 is fastened to the shut-off cock by way of an inlet nipple 9 and a box nut (not shown). The valves 10 and 30 control the water inflow and have respective valve elements 11 and 31, fastened to respective diaphragms 12 and 32 and bounding respective pressure chambers 13 and 33. The valves 10 and 30 are controllable hydraulically. Respective hydraulic duct sections 15 and 35, which are connected together by means of the hydraulic duct section 25, lead into the pressure chambers 13 and 33. The valves 10 and 30 are constructed as hydraulically controllable valves with auxiliary pressure, for which purpose respective control pressure openings 14 and 34 are arranged in the diaphragms 12 and 32 and produce the entry connection of the hydraulic duct sections 15, 25, 35 and 45 with the inlet hose 4. The hydraulic duct section 25 connects the section 35 with the section 15 in such a manner that it projects by one end thereof into the pressure chamber 33 of the valve 30, while its other end ends in the pressure element 25, into which also projects that end of the duct section 15 which is opposite the end projecting into the pressure chamber 13 of the valve 10.

The hydraulic duct section 35 leads to a float valve 40, which is actuated by the float 7 and from which the duct section 45 leads to an electric servo-valve 50 actuated by the program control device of the appliance. The pressure element 20, the float valve 40 and the electric servo-valve 50 act as control valves which, independently of

each other, close at least one of the two valves 10 and 30 through blocking of the hydraulic duct 15, 25, 35 and 45.

The pressure element 20 is arranged in the valve arrangement 2 between the safety valve 10 and the filling valve 30. The pressure element 20 operates on the principle of a permanent magnet armature valve, and comprises a permanent magnet 24 fastened to a diaphragm 22 which separates a first pressure chamber 23 from a second pressure chamber 26. The armature 21, which is spring-loaded and serves as a valve element, is arranged in a switching chamber 27 and in the opened state is attracted by the magnet 24. The pneumatic duct 6, which extends from the pressure chamber 5 of the level-regulating vessel, opens into the first pressure chamber 23 of the pressure element 20. On reaching a set liquid level in the container 3, air pressure is produced in the pressure chamber 5 and conducted by way of the duct 6 to the chamber 23 and thereby so deflects the diaphragm 22 and thus the permanent magnet 24 that the armature 21 closes the hydraulic duct section 25, which defines a valve seat.

The servo-valve 50 includes a valve element 51 in a switching chamber 53, and in the event of appropriate electrical pulses from the program control device the element 51 closes an outlet 55 leading into the inlet hose 4. The hydraulic duct section 45 ends in the chamber 53. By means of the opening or closing of the valve element 51, the hydraulically controlled valves 10 and 30 can be closed independently of the setting of the other control valves.

The float valve 40 includes a permanent magnet 44, which is fastened to the float 7 and in the opened state attracts a spring-loaded armature 41 serving as a valve element. When the float 7 rises due

to the presence of leakage water in the trough, the magnet 44 is moved out of its rest position and the spring-loaded armature 41 closes the end, constructed as a valve seat, of the hydraulic duct section 45 in a switching chamber 43. The duct section 35, which produces the connection between the valve 30 and the float valve 40, ends in the chamber 43. The valves 10 and 30 are thus closed by the float valve 40 independently of the other control valves.

The hydraulic duct section 35 as well as the pneumatic duct 6 extend in the inlet hose 4 from the control valves arranged at the appliance body, i.e. from the float valve 40 and/or servo-valve 50, to the valve arrangement 2.

The water-filling and safety device 1 is shown in a closed state in the drawing. When the servo-valve 50 is opened by a signal from the program control device, the hydraulic control pressure in the hydraulic duct sections 15, 25, 35 and 45 falls off by way of the outlet 55 leading into the inlet hose 4. When the inflow of liquid is terminated by a signal of the program control device, the valve element 51 closes the outlet 55. A hydraulic pressure, which closes the valve elements 31 and 11 of the valves 30 and 10, is built up in the switching chamber 53 of the servo-valve 50 by water, which is conducted by the hydraulic duct 15, 25, 35 and 45 into the chamber 53, entering by way of the control pressure openings 14 and 34 into the pressure chambers 13 and 33 of the valves 10 and 30, since the built-up pressure in the chamber 53 is transmitted by way of the hydraulic duct back to the valve arrangement 2.

The closing operation described above also takes place in the first fault case, i.e. current failure, since the servo-valve 50 is

closed in the current-free state.

In the second fault case, i.e. reaching of a liquid level which leads to response of the pressure chamber 5, the pneumatic pressure is conducted by way of the pneumatic duct 6 into the first pressure chamber 23 of the pressure element 20 and causes the already-described deflection of the magnet 24. When the armature 21 closes the hydraulic duct section 25 as described, a pressure, which by way of the duct section 15 effects closing of the valve element 11 in the valve 10 and thereby interrupts the water supply to the appliance, builds up in the switching chamber 27 due to the water which enters by way of the opening 14 into the pressure chamber 13 and is conducted by way of the duct section 15.

In the third fault case, i.e. the ingress of leakage water into the leakage water collecting trough, the armature 41 closes the duct section 45 as already described, so that a hydraulic pressure builds up in the chamber 43. This pressure is transmitted by way of the duct section 35 to the valve arrangement and leads to closing of the valve 30 and, by way of the duct sections 25 and 15 connecting this with the valve 10, also to the closing of the valve 10.

The water-filling and safety device 1 thus has the advantages that the safety valve 10 and the filling valve 30 are opened and closed together for each water feed controlled by the program control device. It is possible, through the independent arrangement of three control valves (pressure element 20, float valve 40 and electrical servo-valve 50), that all conceivable fault cases independently lead to closing of at least one of the hydraulically controlled valves 10 and 30. Sticking of the safety valve 10 is excluded through the

parallel closing or opening movement of both valves 10 and 30 during each filling operation.

If failure of either of the valves 10 and 30 occurs, the other valve remains capable of function.

If failure of the filling valve 30 occurs, for example due to a foreign body at the seat of the valve element 31, the valve 10 is closed on closing of the servo-valve 50, just as on the closing of the float 40, by way of the hydraulic duct sections 25 and 15 through the hydraulic connection of the valve 30 with the valve 10.

If failure of the safety valve 10 occurs, for example through sticking of the valve element 11 due to a foreign body on the valve seat, the valve 30 is closed on closing of the servo-valve 50 just as in the case of closing of the float valve 40. Since only the safety valve 10 responds on the response of the pressure chamber 5, the safe state of the appliance is ensured by the float valve 40, which closes the filling valve 30.

On failure of the filling valve 30 and response of the pressure chamber 5, the safety valve 10 closes as described above.

Further advantages are achieved through arrangement of the hydraulic duct section 35 and the pneumatic duct 6 in the inlet hose 4, since uniting of the three ducts by means of an additional enveloping hose can be dispensed with.

CLAIMS

1. A liquid-conducting appliance provided with water filling and safety means comprising an inlet hose connected to an inlet of a water container of the appliance, a valve unit for connection of the hose to a source of water supply and comprising two shut-off valves which are arranged in series and which each include a pressure chamber, the hose and valve unit defining an inlet duct, and a plurality of control valves each including a switching chamber, the pressure chambers and switching chambers being arranged in series in a hydraulic duct connected at inlet means thereof to the inlet duct upstream of the upstream one of the shut-off valves and at outlet means thereof to the inlet duct downstream of the downstream one of the shut-off valves, and a first one of the control valves being arranged to control communication of the outlet means of the hydraulic duct with the inlet duct.

2. An appliance as claimed in claim 1, wherein each of the control valves is arranged to control at least one of the shut-off valves, independently of the or each other control valve, through closure of the hydraulic duct.

3. An appliance as claimed in either claim 1 or claim 2, wherein a second one of the control valves has its switching chamber disposed between the pressure chambers of the shut-off valves in the series of chambers in the hydraulic duct.

4. An appliance as claimed in claim 3, wherein the second one of the control valves includes a pressure chamber and is pneumatically

controllable by way of a pneumatic duct connected between that pressure chamber and a pressure chamber of a level-regulating device of the appliance.

5. An appliance as claimed in any one of the preceding claims, wherein said first one of the control valves is controllable by program control means of the appliance.

6. An appliance as claimed in claim 5, wherein said first one of the control valves is an electrical servo-valve.

7. An appliance as claimed in any one of the preceding claims, wherein a third one of the control valves is operable by way of sensing means sensing the level of leakage water in a leakage water collecting vessel of the appliance.

8. An appliance as claimed in claim 7, the sensing means comprising a float.

9. An appliance as claimed in any one of the preceding claims, wherein the hydraulic duct is connected at its inlet means to the inlet duct by way of flow throttling means at the shut-off valves.

10. An appliance as claimed in any one of the preceding claims, wherein the hydraulic duct extends in the inlet hose.

11. An appliance as claimed in any one of claims 1 to 9, wherein the

hydraulic duct is connected to wall means of the inlet hose.

12. An appliance as claimed in any one of claims 1 to 9, wherein the hydraulic duct is formed integrally with wall means of the inlet hose.

13. An appliance as claimed in claim 4, wherein the pneumatic duct extends in the inlet hose.

14. An appliance as claimed in claim 4, wherein the pneumatic duct is connected to wall means of the inlet hose.

15. An appliance as claimed in claim 4, wherein the pneumatic duct is formed integrally with wall means of the inlet hose.

16. An appliance substantially as hereinbefore described with reference to the accompanying drawing.

17. An appliance as claimed in any one of the preceding claims, the appliance being a dishwashing machine.

18. An appliance as claimed in any one of claims 1 to 16, the appliance being a laundry washing machine.

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